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(58) Field of search
H2A

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(54) Electric motor

(57) An electric motor has a cylindrical motor case 4 which is generally closed at one axial end with the motor shaft extending through a motor shaft hole therein. The opposite open axial end of the motor case is provided with a motor case cover 3 having a generally disc-shaped insulator 1 fastened to the axially inner side thereof by means of an upsetting boss 17. The radially outer edge portion of the cover is provided with a circumferentially extending fold or seam 6. The folded or seamed portion 5 forms a press-fit within the open end of the motor case.

FIG. 3

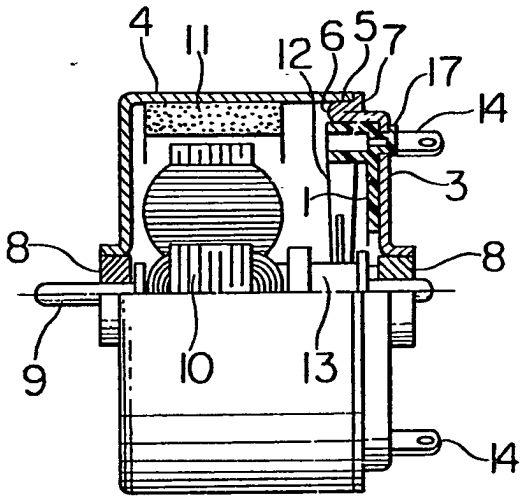

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FIG. 1

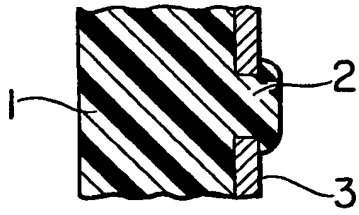


FIG. 2A FIG. 2B FIG. 2C FIG. 2D

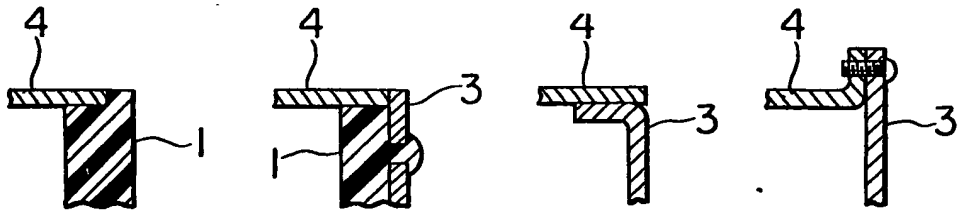


FIG. 3

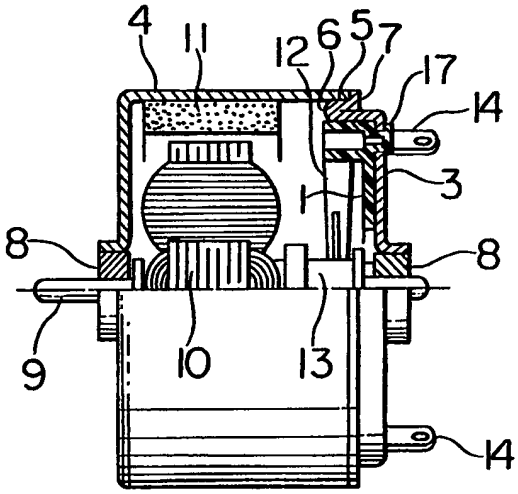


FIG. 4

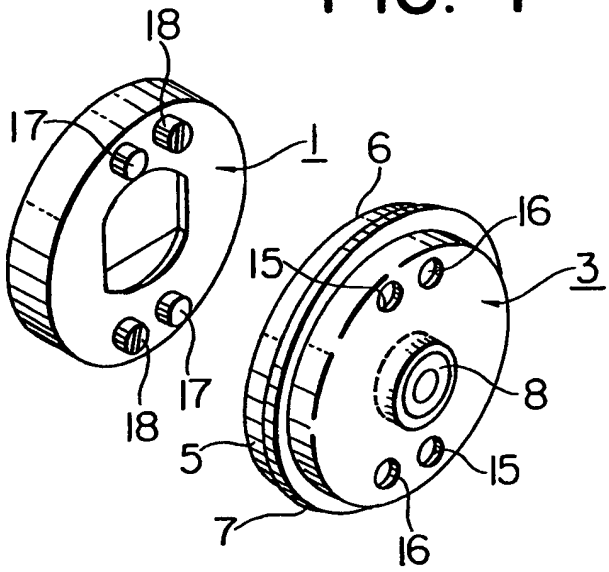


FIG. 5

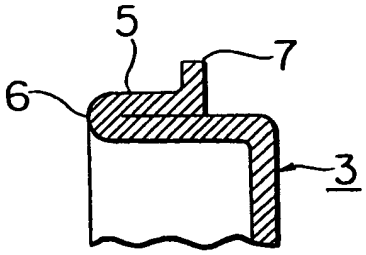


FIG. 6

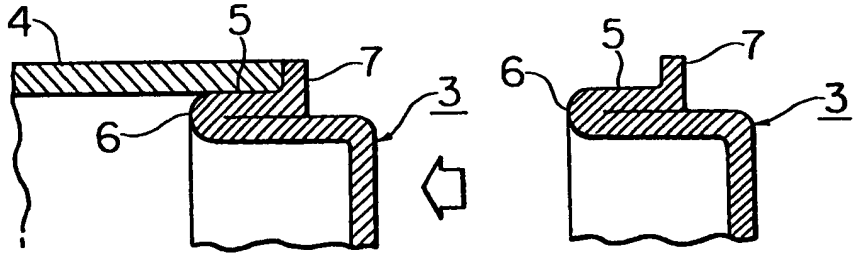


FIG. 7

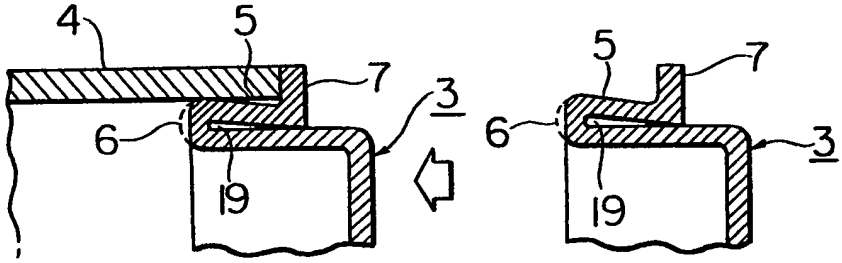


FIG. 8A

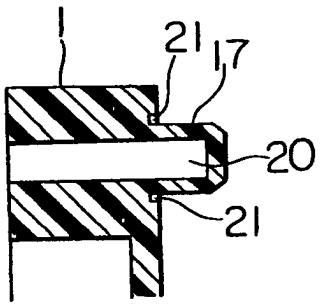


FIG. 8B

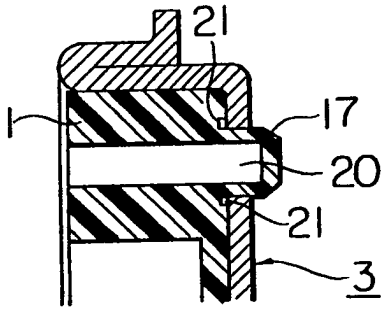


FIG. 8C

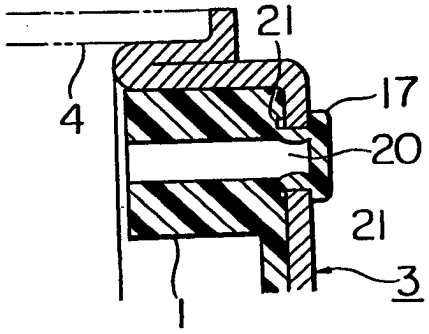


FIG. 9A

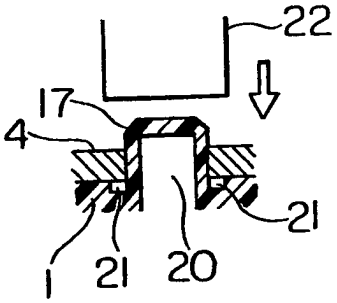


FIG. 9B

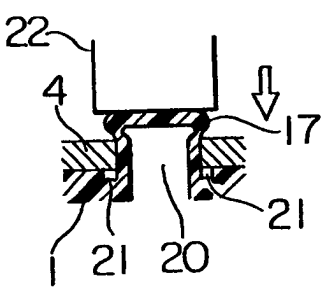
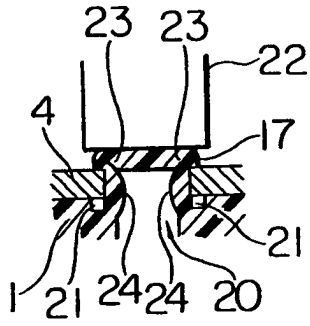


FIG. 9C



SPECIFICATION

Electric motor

This invention relates to electric motors.

So-called "miniature electric motors" are commonly provided with a motor case having a motor case cover made of a synthetic resin material. Such a material enables the relatively complicated structure for mounting brush gear and terminals to be relatively easily formed therein. Secondly, the material concerned is electrically insulating and so enables the brush gear, terminals and other current carrying members to be relatively easily insulated from each other.

However, such material has virtually no electromagnetic noise shielding effect. In order to deal with this problem it has become the practice for the brush gear and terminals to be mounted on synthetic resin material formed into a generally disc shape and itself covered by an external metallic motor case cover.

As we shall explain below with reference to Figs. 1 to 2D of the accompanying drawings, the various prior proposed means for mounting the parts together have suffered from a variety of disadvantages.

The present invention seeks to overcome or at least to mitigate those disadvantages.

In accordance with the present invention there is provided an electric motor having a cylindrical motor case which is generally closed at one axial end with the motor shaft extending through a motor shaft hole therein; the opposite open axial end of the motor case being provided with a motor case cover having a generally disc-shaped insulator fastened to the axially inner side thereof by means of an upsetting boss, the radially outer edge portion of the cover being provided with a circumferentially extending fold or seam, the said folded or seamed portion being adapted to form a press fit within the open end of the motor case.

The invention is hereinafter more particularly described by way of example only with reference to the accompanying drawings, in which:—

Fig. 1 shows how a synthetic resin insulator is joined to a metallic motor case cover by means of upsetting;

Figs. 2A to 2D show different arrangements for coupling the motor case cover to the motor case proper;

Fig. 3 is a side elevational view partly in section showing an embodiment of electric motor constructed in accordance with the present invention;

Fig. 4 is a perspective view of the metallic motor case cover and the cooperating insulator;

Fig. 5 is a sectional view of the radially outer edge portion of the motor case cover;

Fig. 6 shows how the motor case cover forms a press-fit with the motor case proper;

Fig. 7 is a view generally similar to Fig. 6 showing press fitting of a modified embodiment of motor case cover with the motor case;

Figs. 8B and 8C show the insulator and metallic motor case cover in sectional views illustrating successive stages in the upsetting; and

Figs. 9A to 9C illustrate successive stages in upsetting of the boss in an upsetting jig.

Referring first to Fig. 1, which shows a conventional upsetting arrangement, an insulator 1 formed of synthetic resin material is joined by means of an upsetting boss 2 to a motor case cover 3. The upsetting boss 2 is inserted into a boss hole provided on the motor case cover 3 and the head of the boss 2 protruding from the external surface of the motor case cover is upset to secure the motor case cover 3 and the insulator 1. A drawback of this fastening arrangement is that a relatively large force is required to upset the head of the upsetting boss 2 provided on the insulator 1. The upset joint may become loosened with time due to the resiliency of the materials (because they have not been subjected to a complete plastic deformation even after upsetting). Other means involving less loosening of upset portions include hot upsetting and ultrasonic upsetting. These means, however, require expensive equipment and have poor workability.

Various means of engaging the open end face of the motor case with a motor case cover have heretofore been employed, as shown in Figs. 2A to 2D.

Fig. 2A shows an example where the motor case cover is constructed of an insulator formed with a synthetic resin or other material; the insulator 1 is fastened to a motor case 4 by press-fitting a shouldered portion provided on the insulator 1 into the motor case 4. Fig. 2B shows another example where the motor case cover is made of a metal, an insulator 1 being fixedly fitted to the metallic motor case cover 3 by upsetting or other means, and the insulator 1 being press-fitted to the motor case 4. Fig. 2C shows still another example where the motor case cover 3 is formed by bending a metallic plate by press working; the bent portion being press-fitted to the motor case 4. Fig. 2D shows an example where a bent portion is provided on the open end face of the motor case 4. In this case, the motor case cover 3 is joined to the motor case 4 with screws.

Where these arrangements consist of or include an element made of synthetic resin material, it proves difficult to maintain dimensional accuracy because of thermal deformation and secular change in the resin. Moreover, synthetic resin material has negligible electromagnetic shielding effect. On the other hand, where the motor case cover is made of metal, or includes metal, there tend to be problems with the means by which the cover is press-fitted or otherwise coupled to the motor case.

Referring now to Figs. 3 to 6, it will be seen that in the illustrated embodiment of electric motor constructed in accordance with the present invention, the radially outer edge portion 5 adapted to form a press-fit within the motor case 4 is provided with a circumferentially extending folded or seamed portion at 6. The double-folded

drawing or press working of a metal blank such as sheet steel. More specifically, the illustrated construction can be produced by bending a press-fitting portion of the metallic motor case cover 3 outwardly and back on itself to form the folded or seamed portion 6. A radially extending flange 7 is provided by bending the folded edge at right angles.

A motor case cover of this construction can be press-fitted into the open end of the motor case 4 as shown in Fig. 6 until the edge of the opening of the motor case 4 reaches the flange portion 7 which acts as a stop. This arrangement avoids the need for engagement means such as pawls or screws (though additional fixing means such as screws may be used as well if desired). However, where additional fixing means are not used, the illustrated construction has the advantage that it enables the phase angle of the motor to be freely determined. This is because the brush gear and releated equipment are mounted from the motor case cover. Thus, the precise angular position of the motor case cover relative to the other components of the motor within the case 4 may be selected as desired, the position not being pre-set by the construction of means for engaging the motor case cover with the motor case, as in some prior art arrangements. Additionally, as the portion 5 which forms a press-fit within the motor case 4 has a thickness which is double that of the other parts of the motor case cover 3, the strength of the portion 5 is effectively increased, which may make it possible to reduce the thickness of the material of the blank from which the motor case cover 3 is produced. Possible variations in thickness can also be more readily absorbed. The rounded leading end of the folded or seamed portion 6 facilitates entry of the press-fitting portion 5 within the motor case 4. We have also found that the successive press working or drawing operations necessary to form the motor case cover with the edge configuration shown in Fig. 5 has the effect of increasing the accuracy with which the motor case cover is truly round. This makes it possible to use a relatively inexpensive plain bearing 8 on the axial centre-line of the motor case cover rather than a relatively more expensive self-aligning bearing for accuracy in supporting the motor shaft 9 (see Fig. 3).

Referring to Fig. 3, it will be seen that the motor case 4 is generally closed at one axial end, with the motor shaft 9 extending through a motor shaft hole therein provided with a further bearing 8. The rotor core and windings 10 are mounted in conventional fashion on the shaft 9. Permanent magnets 11 are fixed interiorly of the motor case 4 to provide a stator. Brush gear 12 is mounted on the insulator 1 which is fastened to the axially inner surface of the motor case cover 3 in a fashion to be explained further below and the brushes 12 make operative contact with a commutator 13 which is also mounted on the rotor shaft 9. Terminals 14 which may be integral with the brushes 12 extend through the insulator and motor case cover 3 to the exterior of the motor for connection in an external electric circuit. Since the arrangement illustrated in Fig. 3 has no engagement means which necessarily therefor must have a particular relative angular orientation when coupled together, the phase angle of the motor can be readily adjusted by press-fitting the cover 3 to the case 4 in any selected angular orientation having regard to the positions of the permanent magnets 11.

The insulator 1 and the metallic motor case cover 3 are fastened together in a manner to be described below with reference to Figs. 8A to 9C. As will best be seen in Fig. 4, the metallic motor case cover 3 has four openings therethrough of which two such openings serve as boss holes while the other two openings serve as terminal holes. In a corresponding fashion the insulator 1 has hollow upsetting bosses 17 which are adapted to be received through the boss holes 15 and terminal mounts 18 adapted to be received through the terminal holes 16. The terminal mounts 18 have openings therethrough in which the terminal 14 is received so as to pass through the motor case cover 3 while being electrically insulated therefrom.

Fig. 7 is a view generally similar to that of Fig. 6 and shows the press-fitting engagement between the motor case cover 3 and the motor case 4 in a modified embodiment. In this embodiment, the axially leading end of the folded or seamed portion 6 is pressed axially by press working so that the fold or seam collapses to some extent, creating a space 19 within the press-fitting portion 5. The effect of this is to increase the resiliency of the press-fitting portion 5, enabling variations in thickness or in the dimensions to be absorbed by the increased resiliency. At the same time, the arrangement tends to make the thickness of the seamed or folded portion greatest adjacent its leading axial edge with the result that a positive engagement between the cover 3 and the case 4 is more securely made at a greater depth into the motor case 4, as best shown in Fig. 7, which enhances the coupling between these two elements.

Referring next to Fig. 8A, the hollow upsetting boss 17, which is integrally formed with the insulator 1 has an axially extending hollow 20, the head of the boss being closed. Boss 17 is received through the boss opening in the metallic motor case cover 3 as shown in Fig. 8B. The boss 17 has its outer diameter selected to allow a slight press-fit (approximately 0.05 mm of press-fit allowance), and a circumscribing annular recess 21 is provided about the root of the boss 17 to increase the upsetting effect and workability. Fig. 8C shows the state where the head of the upsetting boss 17 in the state shown in Fig. 8B is upset after being subjected to the process illustrated in Figs. 9A to 9C to securely join the motor case cover 3 with the motor case 4.

Fig. 9A shows an assembly of the metallic motor case cover 3 and the insulator 1 as shown in Fig. 8B set on an upsetting jig 22. The head of the upsetting boss 17 is upset by the upsetting jig 22 as shown in Fig. 9B. When upset, the head of the upsetting boss 17 expands in the radial direction, with the height of the head being reduced. Fig. 9C shows the finished state where the head of the upsetting boss 17 has

hollow upsetting boss 17, when upset, produces folds 23 at the inside corners of the head and bulges 24 on the inside surface of the hollow part 20, resulting in a complete plastic deformation.

We have found that with this particular configuration for the boss, the plastic deformation occurs in a way which causes a stronger fastening force than with the prior art solid upsetting bosses as shown in Figs. 1 and 2B. Thus, we achieve a stronger fastening effect between the insulator and the metallic motor case cover and high dimensional stability due to less secular change.

CLAIMS

1. An electric motor having a cylindrical motor case which is generally closed at one axial end with the motor shaft extending through a motor shaft hole therein; the opposite open axial end of the motor case being provided with a motor case cover having a generally disc-shaped insulator fastened to the axially inner side thereof by means of an upsetting boss, the radially outer edge portion of the cover being provided with a circumferentially extending fold or seam, the said folded or seamed portion being adapted to form a press-fit within the open end of the motor case.

2. A motor according to Claim 1, wherein the folded or seamed portion has a double thickness of material and is formed by folding a metallic blank by press working.

3. A motor according to Claim 2, wherein the apex of said folded or seamed portion is collapsed axially to create a space within said folded or seamed portion.

4. A motor according to any preceding claim, wherein the motor case cover has a radially upwardly directed flange which determines the extent by which the said folded or seamed portion can be press-fitted within the motor case.

5. A motor according to any preceding claim, wherein the said insulator is fastened to the axially inner side of the said motor case cover by the said upsetting boss by the motor case covered being provided with a boss hole and the insulator being provided with a hollow boss, the hollow boss being inserted into the boss hole and then upset.

6. A motor according to Claim 5, wherein the root end of the said boss is provided with a circumscribing annular recess, the effect of which is to enhance the upsetting effect when said boss is upset.

7. An electric motor substantially as herein before described with reference to and as shown in Figs. 3 to 9C of the accompanying drawings.

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